Site Need Statement

General Reference Information	
1 *	***Need Title*:** Pretreatment Approaches to Mitigate Sulfate Issues in LAW Immobilization
2 *	***Need Code:*** RL-WT120
3 *	***Need Summary*:** Sulfate, which is a significant component in the supernate fractions of many tank wastes at Hanford, poses serious economic impacts (creating more glass) and risks for the LAW vitrification process. Sulfate tends to phase separate in the melter forming a corrosive molten sulfate salt layer on top of the glass melt that will damage the melter if allowed to accumulate. This problem can be mitigated by removing sulfate from the LAW before vitrifyingRemoving sulfate from the LAW before vitrifying can mitigate this problem, and new cost-effective separation technologies are needed.
4 *	***Origination Date*:** FY 2002 (November 2001)
5 *	***Need Type*:** Technology Need
6	***Operation Office*:** Office of River Protection (ORP)
7	***Geographic Site Name*:** Hanford Site
8 *	***Project*:** Office of River Protection - Treat Waste Balance of Mission Waste Treatment and Immobilization Plant ***PBS No:*** ORPRL-TW076
9 *	***National Priority:*** ____1. High - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. __X_2. Medium - Provides substantial benefit to EM program projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays). ____3. Low - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	***Operations Office Priority*:**
Problem Description Information	
11	***Operations Office Program Description*:** Hanford tank wastes will be retrieved and delivered to the RPP-WTP where it will be separated during pretreatment into high level waste (HLW) and low activity waste (LAW) fractions, both of which will be immobilized by vitrification for disposal as glass in canisters.
12	***Need/Problem Description*:** Sulfate separation became a particularly important LAW vitrification issue for the RPP-WTP following a conclusion in January 2000 that the initially proposed ion exchange technology would not sufficiently remove sulfate from LAW liquids. This could result in an estimated 20% increase in the amount of ILAW glass produced from sequentially processing all 177 tanks at the Hanford site. Separating sulfate from highly alkaline salt solutions containing several molar concentrations of competing ions such as hydroxide, nitrate, nitrite, and carbonate is an unusual and difficult separation. The sulfate removed from the LAW stream as a secondary waste must also be suitable for disposal, and the separation technology should have a minimal impact on the vitrification of the treated LAW stream. Because sulfate is only sparingly soluble in LAW glass melts, it can form a molten sulfate salt layer on top of the glass melt if the solubility limit is exceeded. A molten sulfur layer in the LAW melter can lead to accelerated corrosion of the melter and unacceptable operating conditions (e.g. steam explosion or a sulfur waste form that does not meet the acceptance criteria). The problems associated with sulfate in the LAW feed could be mitigated through either pretreatment to remove sulfate, or through improving the vitrification technology such that more sulfate can be incorporated into the ILAW. The latter approach is discussed under a separate technology need (RL-WT101). This need statement addresses the mitigation strategy in which sulfate is separated from the LAW feed before vitrification.

13	• ***Functional Performance Requirements*:** • Ability to separate sulfate from highly alkaline salt solutions containing several molar concentrations of competing ions such as hydroxide, nitrate, nitrite, and carbonate. • Sulfate-depleted LAW must yield a Na_2O * SO_3 concentration in the glass product of less than 5 wt%. This is the assumed constraint for preventing sulfate salt separation in the melter. • The separated sulfate must not be in a form that prevents disposal by an alternative disposal path.
14	***Definition of Solution*:** The sulfate in LAW mitigation needs will be satisfied when a reliable and cost effective sulfate separation method has been developed and demonstrated on actual LAW feed.
15 *	***Targeted Focus Area*:** Tanks Focus Area (TFA)
16	***Potential Benefits*:** The major benefit of the sulfate removal technology is to reduce the overall life cycle cost of the RPP mission by reducing the volume of ILAW. The presence of sulfate in the LAW feed to the melter is expected to increase the operating time and amount of LAW glass produced from minimum order quantity feeds by ~25%. The impact on the Balance of Mission is expected to be even larger. Other benefits include reduced worker dose commensurate with the reduced operating time and reduced frequency of melter maintenance and replacement.
17 *	***Potential Cost Savings*:** $500M to $1B
18 *	***Potential Cost Savings Narrative*:** LAW vitrification cost savings would include avoidance of ~$520M in capital construction costs for a second facility plus reduced operating and ILAW disposal costs.
	***Technical Basis*:** Current LAW glass formulations on the RPP-WTP Project are limited by the Na_2O * SO_3 concentration product less than 5 wt% constraint. This preliminary empirical constraint was developed by recent glass formulation and melter testing programs, and reduces potential waste loadings of some waste types (e.g., AZ-102 and AN-102) by more than 60%. An estimated 20% additional amount of ILAW glass is expected to be produced from sequentially processing all 177 tanks at the Hanford site. Blending of LAW feeds solutions could reduce the estimated increase in ILAW glass production.
19	***Cultural/Stakeholder Basis*:** The River Protection Project is committed to moving forward to design, construct, and put into operation the Waste Treatment and Immobilization Plant on the schedule recently agreed to in the Tri-Party Agreement. A robust program is necessary to ensure that delays, all of which are costly, are minimized. A key part of this risk mitigation is to include in the total program a capability to test with actual wastes the processes and equipment planned, or later in use.
20	***Environment, Safety, and Health Basis*:** A reduction in the amount of ILAW product that needs to be processed, and less frequent melter maintenance and replacement campaigns, will result in less worker dose.
21	***Regulatory Drivers*:** Environmental Impact Statement (EIS) for the Tank Waste Remediation System (TWRS) (DOE-RL and Ecology 1996) and the Hanford Federal Facility Agreement and Consent Order (known as the Tri-Party Agreement) and its amendments. DOE has negotiated additions to the Tri-Party Agreement that require the retrieval of single shell tanks by 2018, and the startup and operation of the WTP to support the treatment and immobilization of tank waste. By operating the WTP not only is that capability demonstrated and about 10% by volume (25% by activity) of the tank waste processed, but space is made available in the double shell tanks to allow the single shell tank retrieval to proceed without the expenditure of vast sums for additional double shell tanks. Other regulatory drivers include gathering the data necessary for the regulatory permits required for the startup and operation of the facility.
22 *	***Milestones*:** November 15, 1999 tTri-Pparty Aagreement on principal regulatory commitments: • Start (Hot) commissioning-Phase I Treatment Complex 12/2007 • Start Commercial Operation-Phase 1 Treatment Complex 12/2009 • Complete Phase I-Treatment (no less than 10% of the tank waste by volume and 25% of the tank waste by activity) 12/2018 Other selected TPA milestones are: • Retrieve all SSTs 2018

	• Close SSTs 2024 • Immobilize remaining tank waste 2028 • Close all tanks 2032
23 *	***Material Streams*:** ID-3857 HLW to Treatment Risk Score: 3Hanford High-Level Defense Waste. The River Protection Project (formerly known as the Tank Waste Remediation System) involves PBSs RL TW-01 through TW-09. The technical, work scope definition, and intersite dependency risks for Phase 1 Waste Treatment and Immobilization is respectively, 3,3,3 on a scale of 1 to 5 where "5" represents high programmatic risk. This stream is on the critical closure path for Hanford Site cleanup.
24	***TSD System*:** Hanford Waste Treatment and Immobilization Plant. Technical risk is timely startup of this plant and its ability to operate at planned throughput (capacity and operating efficiency).
25	***Major Contaminants*:** The major radioactive contaminants in the Hanford tank supernatant and salt cake wastes prior to pretreatment include Cs, Tc, Sr, and TRU.
26	***Contaminated Media*:** Any equipment (e.g., precipitation tanks, ion exchange column, liquid-liquid extraction contactors) used in the sulfate separation process will be contaminated internally from the LAW feed. The equipment can likely be designed so that it can be contact maintained.
27	***Volume/Size of Contaminated Media*:** The Hanford Site has 177 underground tanks that store 204 million liters (54 M gallons) of waste containing about 190 MCi of activity.
28 *	***Earliest Date Required*:** Early technology insertion is possible if completion occurs by 2005
29 *	***Latest Date Required*:** To support BOM WTP design decisions and future operations, a FY 2008 completion date will be required
Baseline Technology Information	
30	***Baseline Technology/Process*:** The current baseline technology for LAW sulfate mitigation is a conservative process approach that limits the waste loadings in LAW glasses such that the product of the wt% of Na_2O times the wt% SO_3 in the glass does not exceed 5. Glasses meeting this constraint are generally processable without formation of a sulfate salt layer. **Technology Insertion Point(s):** N/A
31	***Life-Cycle Cost Using Baseline*:** The current baseline for the WTP is several billion dollars, with the BNI estimate itself is in the $4 billion range. The current River Protection Project life cycle costs are estimated at approximately $50 billion.The current baseline for the WTP is several billion dollars. The current River Protection Project (formerly known as Tank Waste Remediation Systems) life cycle costs are estimated at approximately $50 billion.
32	***Uncertainty on Baseline Life-Cycle Cost*:** There is large uncertainty in the WTP life-cycle cost, providing the opportunity to reduce the life-cycle cost due to operation improvements as well as ensuring operational success not to add additional cost to the system.Currently there is large uncertainty in the WTP life-cycle cost, and it will be revised after the new Design and Construction contractor is put under contract early in FY2001.contract early in FY2001.
33	***Completion Date Using Baseline:*** Plant operations will be completed between 2028 and 2040.Currently there is large uncertainty in the WTP life-cycle cost, and it will be revised after the new Design and Construction contractor is put under contract early in FY2001.
Points of Contact (POC)	
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